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Fuel Continuity

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Synonyms

Fuel connectivity; Fuel distribution; Fuel mosaic; Homogenous fuels

Definition

Fuel continuity is the degree or extent of continuous or uninterrupted distribution of fuel particles in a fuel bed thus affecting a fire's ability to sustain combustion and spread. This applies to ladder fuels as well as surface fuels (NWCG 2018).

Introduction

All vegetative biomass is potentially fuel for wildfires. The physical characteristics of vegetative biomass or fuels that influence wildfire behavior and effects are the total quantity of fuel available to burn, the size (diameter) of the fuels, the moisture content or fuel moisture of the fuels, and how the fuel is distributed. Fuels are distributed both vertically and horizontally; the vertical and horizontal distribution of the fuels is commonly referred to as *fuel continuity.* Continuous fuels are necessary for fire to spread across the landscape or from the forest floor into the canopy. Fuel continuity is such a fundamental concept in fire science for understanding why ignitions (lightning or human caused) are sustained and able to spread from one source of fuel to another that most authors (for example Keane et al. 2001, 2009; Reinhardt et al. 2008; Paysen et al. 2000) discuss fuel continuity but do not define the term as it is assumed to be common knowledge.

Vertical Fuel Continuity

Vertical fuel continuity refers to how connected the biomass fuels are from the mineral soil/duff interface to the needles on the top of the trees (Fig. 1). The fuels that connect the forest floor (litter and duff) to top of canopy trees are often referred to as ladder fuels or aerial fuels. These fuels include grasses, shrubs, small trees, and the lower branches of canopy trees. These ladders of continuous fuels between the surface and canopy fuels allow the spread of fire into the canopy where the wind can have a greater influence on horizontal fire spread and result in large stand-replacing wildfires.

Horizontal Fuel Continuity

Horizontal fuel continuity refers to how spatially connected fuels are within landscapes. Horizontal fuel continuity can occur at many spatial scales from meters to kilometers (Fig. 2). Continuous

S. L. Manzello (ed.), *Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires*,
https://doi.org/10.1007/978-3-319-51727-8_239-1

Fuel Continuity, Fig. 1 Vertical fuel example. The scene on the left illustrates a condition where the fuels are very connected vertically. Small trees that potentially lift the fire are present and the lower branches on larger trees persist nearly to the ground effectively creating a connected vertical fuel bed from the forest floor to the top of the canopy. The right scene shows an area where the fuels have been treated and most of the small trees and lower branches on larger trees have been removed. The spatial fuel continuity has remained on the forest floor as no dead surface fuels were removed but the vertical fuel continuity is reduced. (Photo credit SDrury)

Fuel Continuity, Fig. 2 Spatial fuel continuity in interior Alaska. Large landscape that has been burned repeatedly over several decades. Landscape is composed of multiple aged stands. Fuels were spatially disconnected after most recent fire but with the time the vegetation has recovered creating a spatially continuous live fuel layer

interconnected fuels on the ground, such as grass or litter fuel beds, largely determine if a fire will carry, or spread, from one part of the landscape to another.

As mentioned, wildland fire scientists commonly refer to fuel continuity but do not describe it. However, Charles Cooper (1960) provided one of the earliest and best descriptions of vertical and horizontal fire continuity when he described how fire exclusion altered vegetation structure and function in Southwestern ponderosa pine forests. Cooper discussed how fire exclusion increased fuel continuity by enabling more small trees to persist within the landscape (vertical and horizontal fuel connectivity), by allowing increased numbers of live needles to remain on the lower portion of tree crowns (vertical fuel connectivity) and the buildup of needles and branches across the forest floor (horizontal fuel connectivity).

Reducing Fuel Continuity

Low-intensity burning during prescribed fire or wildland fire can decrease vertical fuel continuity by removing live needles on lower tree branches and removing small trees which raises the crown base heights and separates the canopy fuels from the forest floor or ground fuels (dead needles and branches on the ground). Horizontal fuel continuity is decreased by removing the litter and dead fine branches on the ground, creating fuel gaps in the landscape. More intense burning can create spatial heterogeneity (decrease horizontal fuel continuity) by burning stumps, logs, or jack pots of woody debris which kills trees in immediate vicinity, creating holes in the canopy and removing ground fuels. Not enough needles fall in open areas created by fire to allow for the spread of fire across fire-created openings. Very intense burning during stand-replacing fires can create greater levels of spatial fuel discontinuity by killing all above ground vegetation, removing burnable fuels for several years to decades until the vegetation recovers.

Fuel treatments and grazing by animals can also reduce fuel continuity by removing the fuel available to burn either vertically or horizontally. Animals eat fine fuels such as grasses and small trees and shrubs, breaking up the fuel continuity. Fuels treatments remove fuels by cutting trees and shrubs and moving them off site, burning the fuels during low-intensity prescribed burns, or reduce vertical fuel continuity by breaking and crushing the fuel to bring the shrub and small tree fuels closer to the ground (mastication).

Cross-References

- ▸ Canopy Fuel
- ▸ Crown Fire
- ▸ Fuel Loading
- ▸ Fuel Moisture
- ▸ Ground Fuel
- ▸ Ladder Fuel
- ▸ Masticated Fuels
- ▸ Prescribed Burning
- ▸ Surface Area-to-Volume Ratio
- ▸ Surface Fire
- ▸ Surface Fuel
- ▸ Surface to Crown Transition
- ▸ Torching
- ▸ Wildland Fuel Treatment

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